

Science Fair Research Report Guideline

Developed using content directly from:

Writing a Scientific Research Paper.

columbia.edu, columbia.edu/cu/biology/ug/research/paper.html

Science Fair Research Report TEMPLATE. ”

sequoiasecondary.org, sequoiasecondary.org/.../ScienceFair/Science%20Fair%20Research

Freeman, Dennis M. “Guide for Writing Scientific Research Paper.”

umech.mit.edu, <http://umech.mit.edu/freeman/6.021J/2000/writing.pdf>

Interesting & Descriptive Title

Don't be boring!

centered on page

Add pictures, borders, etc to make the title page more interesting, do not overdo it here

Abstract

Format: The Abstract is a single paragraph that summarizes your entire project. The abstract should be on the first page after the title page, and it should be on a page by itself. **Content:** The first sentence should be your purpose. The second sentence should be your scientific question. The third sentence should be your hypothesis. The fourth sentence should be a brief description of your procedure; do not include details here. The fifth sentence should summarize your results. The sixth and last sentence should be your conclusion, including whether or not your hypothesis was supported.

1. An abstract, or summary, is published together with a research article, giving the reader a "preview" of what's to come. Such abstracts may also be published separately in bibliographical sources, such as Biological Abstracts. They allow other scientists to quickly scan the large scientific literature, and decide which articles they want to read in depth. The abstract should be a little less technical than the article itself; you don't want to dissuade your potential audience from reading your paper.
2. Your abstract should be one paragraph, of 100-250 words, which summarizes the purpose, methods, results and conclusions of the paper.
3. It is not easy to include all this information in just a few words. Start by writing a summary that includes whatever you think is important, and then gradually prune it down to size by removing unnecessary words, while still retaining the necessary concepts.
3. Don't use abbreviations or citations in the abstract. It should be able to stand alone without any footnotes.

Introduction

Format: The Introduction Section should begin on a separate page and follow immediately after the abstract.

What question did you ask in your experiment? Why is it interesting? The introduction summarizes the relevant literature so that the reader will understand why you were interested in the question you asked. One to four paragraphs should be enough. End with a sentence explaining the specific question you asked in this experiment.

Purpose

Format: One sentence. Avoid the use of personal pronouns (I, we). **Content:** Explain why you performed this experiment, what you hoped to find out.

Problem

Format: One sentence in question form. **Content:** A **testable** (scientific) question that your experiment tries to answer. Your question should include a reference to your dependent variable. Do not ask “why” questions, they are not answerable through your research here.

Research

Format: One or more paragraphs. Photos, sketches, or illustrations of the information discussed can be helpful to the reader. **Content:** A summary of the information you learned in your research that helped you to form your hypothesis. Review relevant research to provide rationale. (What conflict or unanswered question, untested population, untried method in existing research does your experiment address? What findings of others are you challenging or extending?)

This paragraph should explain the scientific concepts (ideas) you are exploring, and help the reader understand how you decided what your hypothesis should be.

Hypothesis

Format: One sentence. **Content:** A testable statement, referring to the dependent variable (what you will be measuring). Do not use personal pronouns (I, we). Do not start with “think” or “feel”, as thoughts and feelings cannot be measured scientifically. Do not include explanations, “because...”. The explanation should be in your research section.

Methods

Format: The Methods section may start on a new page, or it may follow on the page containing the introduction section.

- How did you answer this question? There should be enough information here to allow another scientist to repeat your experiment. Look at other papers that have been published in your field to get some idea of what is included in this section.
- Mention relevant ethical considerations. If you used human subjects, did they consent to participate. If you used animals, what measures did you take to minimize pain?

Subjects

Format: Simple list. **Content:** Description of what is being tested.

Variables

Independent: **Format:** name of variable **Content:** what you are **changing** on purpose to see how your results change.

Dependent: **Format:** name of variable. **Content:** what you are **measuring** in your experiment

Controlled: **Format:** list of things that could vary (change), but you are keeping the same so that you can be sure that any change in your results is from the change you made to the independent variable. **Content:** complete list of anything that could change and affect the results, but that you are being careful to keep the same

Materials

Format: List, preferably with one item per line. Lists of items in paragraph form are more difficult to read. **Content:** All materials and equipment used in performing the experiment. Remember to include the device or equipment you used to measure your dependent variable, include how these were set up.

- Provide enough detail for replication. Include, for example, genus, species, strain of organisms; their source, living conditions, and care.
- Sources (manufacturer, location) of chemicals, technology, and apparatus.

Procedures

Format: Numbered list, with each new number beginning on its own line. **Content:** **Specific** list of steps that would allow another researcher to duplicate your experiment. Get right to the point with the procedures here. Remember to include **how you measured your dependent variable**. Use only SI (metric) units.

Include exact detailed procedures that contain instruction for every single part of your experiment in the appendices - more details, the better.

- If you had a complicated protocol, it may helpful to include a diagram, table or flowchart to explain the methods you used.
- Explain the steps you took in your experiment. (These may be subheaded by experiment, types of assay, etc.)
- Order procedures chronologically or by type of procedure (subheaded) and chronologically within type.
- Do not put results in this section. You may, however, include preliminary results that were used to design the main experiment that you are reporting on. ("In a preliminary study, I observed the owls for one

Results

Format: The Results section may start on a new page, or it may follow on the page containing the Methods section. **Content:** The research report MUST include your experimental data, that is, the measurements you took.

1. This is where you present the results you've gotten. Use graphs and tables if appropriate, but also summarize your main findings in the text. Do NOT discuss the results or speculate as to why something happened; that goes in the Discussion.
2. You don't necessarily have to include all the data you've gotten during the semester. This isn't a diary.
3. Use appropriate methods of showing data. Don't try to manipulate the data to make it look like you did more than you actually did.

"The drug cured 1/3 of the infected mice, another 1/3 were not affected, and the third mouse got away."

Table(s)

Format: A grid to present your numerical results. The table(s) must have a title. Rows and columns must be labeled correctly. Units must be included in the title and/or row and/or column labels. See the examples below (Note: the data is made up, and the averages are approximate). **Content:** You MUST report your raw data for ALL of your trials. Calculate and present averages or trends in a separate table. Use only SI (metric) units.

Height of Bottle Rocket in Meters

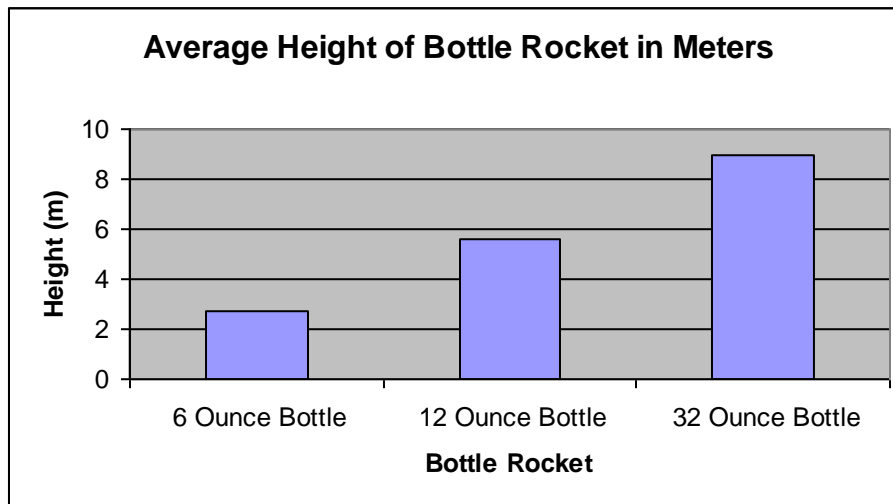
Trial	6 Ounce Bottle	12 Ounce Bottle	32 Ounce Bottle
1	2.1	5.7	8.4
2	3.2	4.8	9.0
3	3.4	6.2	9.6

Average Height of Bottle Rocket in Meters

6 Ounce Bottle	12 Ounce Bottle	32 Ounce Bottle
2.7	5.6	9.0

Graph(s)

Format: Generally it is better to graph the trends or averages rather than the raw data. Do NOT use pie charts unless you measured parts of a whole that add up to 100%; there are almost no instances in which pie charts would be appropriate for these research reports. Use **line** graphs or **bar** graphs. If Time is one of your variables, always put it along the X (horizontal) axis. Graphs should have a meaningful title. X and Y axes and data series should be labeled. Only SI (metric) units should be used and they should be clearly shown on the graph. Use color if at all possible. **Content:** Averaged data or raw data with trend lines to make results more easily seen.



Analysis

Format: Paragraph. **Content:** Describe your results in words. Do not include long lists of numbers, readers will refer to your data tables for that. Describe the differences between trials in terms of percent or size of the change ("Trial 1's result was 50% larger than Trial 2's, but 25% smaller than Trial 3's.") . State whether or not your hypothesis was supported, and how it is supported.

Discussion

Format: The Discussion section may start on a new page, or it may follow on the page containing the Results section.

1. Highlight the most significant results, but don't just repeat what you've written in the Results section. How do these results relate to the original question? Do the data support your hypothesis? Are your results consistent with what other investigators have reported? If your results were unexpected, try to explain why. Is there another way to interpret your results? What further research would be necessary to answer the questions raised by your results? How do your results fit into the big picture?

2. End with a one-sentence summary of your conclusion, emphasizing why it is relevant.

Conclusion

Format: Paragraph **Content:** Summarize the results of the experiment. Compare your results to your hypothesis and state whether or not your hypothesis was supported. Explain why the results turned out the way they did, referring to your research, materials, and procedures.

Application

Format: Sentence or short paragraph. **Content:** Describe how your project relates to real world situations.

Recommendations

Format: Paragraph. **Content:** Describe how you would improve the project if you were to do it again. Make suggestions for how your research could be extended. Explain any mistakes you think you made and how they could be avoided if you were to do the project again.

Acknowledgements

This section is optional. You can thank those who either helped with the experiments, or made other important contributions, such as discussing the protocol, commenting on the manuscript, or buying you pizza.

Works Cited

Format: The Bibliography must be on its own page. This page should be the last page of the research report. Formatting is VERY IMPORTANT in the bibliography. Sources should be listed in alphabetical order. Follow the guidelines for the different types of source materials in your hardcopy packet, or use this website: <http://www.bibme.org/> to build your bibliography, and then copy and paste the correctly formatted information here. **Content:** List all of the resources (books, magazines, web sites, personal interviews, package labels, etc) used in your research and doing the experiment.

If you reference an outside source in your report, you should cite where you found that source. You should also cite sources which your reader, a fellow student, may be unfamiliar with. The appropriate style for citing sources in this report is APA style. Cite only material that you have actually read.

See example

For a complete reference guide to citing sources, see

<https://owl.english.purdue.edu/owl/resource/747/01/>
<http://www.bibme.org/citation-guide/mla>

References (Works Cited)

There are several possible ways to organize this section. Here is one commonly used way:

1. In the text, cite the literature in the appropriate places:

Scarlet (1990) thought that the gene was present only in yeast, but it has since been identified in the platypus (Indigo and Mauve, 1994) and wombat (Magenta, et al., 1995).

2. In the References section list citations in alphabetical order.

Indigo, A. C., and Mauve, B. E. 1994. Queer place for qwerty: gene isolation from the platypus. *Science* 275, 1213-1214.

Magenta, S. T., Sepia, X., and Turquoise, U. 1995. Wombat genetics. In: *Widiculous Wombats*, Violet, Q., ed. New York: Columbia University Press. p 123-145.

Scarlet, S.L. 1990. Isolation of qwerty gene from *S. cerevisiae*. *Journal of Unusual Results* 36, 26-31.

Appendix

Appendices include the original data taken during the laboratory session. Appendices should be numbered A, B, C, etc.

EDIT YOUR PAPER!!!

"In my writing, I average about ten pages a day. Unfortunately, they're all the same page."

Michael Alley, *The Craft of Scientific Writing*

A major part of any writing assignment consists of re-writing.

Write accurately

1. Scientific writing must be accurate. Although writing instructors may tell you not to use the same word twice in a sentence, it's okay for scientific writing, which must be accurate. (A student who tried not to repeat the word "hamster" produced this confusing sentence: "When I put the hamster in a cage with the other animals, the little mammals began to play.")
2. Make sure you say what you mean.

Instead of: The rats were injected with the drug. (sounds like a syringe was filled with drug and ground-up rats and both were injected together)

Write: I injected the drug into the rat.

3. Be careful with commonly confused words:

Temperature has an *effect* on the reaction.

Temperature *affects* the reaction.

I used solutions in various concentrations. (The solutions were 5 mg/ml, 10 mg/ml, and 15 mg/ml)

I used solutions in varying concentrations. (The concentrations I used changed; sometimes they were 5 mg/ml, other times they were 15 mg/ml.)

Less food (can't count numbers of food)

Fewer animals (can count numbers of animals)

A large amount of food (can't count them)

A large number of animals (can count them)

The erythrocytes, which are in the blood, contain hemoglobin.

The erythrocytes that are in the blood contain hemoglobin. (Wrong. This sentence implies that there are erythrocytes elsewhere that don't contain hemoglobin.)

Write clearly

1. Write at a level that's appropriate for your audience.

"Like a pigeon, something to admire as long as it isn't over your head." Anonymous

2. Use the active voice. It's clearer and more concise than the passive voice.

Instead of: An increased appetite was manifested by the rats and an increase in body weight was measured.

Write: The rats ate more and gained weight.

3. Use the first person.

Instead of: It is thought

Write: I think

Instead of: The samples were analyzed

Write: I analyzed the samples

4. Avoid dangling participles.

"After incubating at 30 degrees C, we examined the petri plates." (You must've been pretty warm in there.)

Write succinctly

1. Use verbs instead of abstract nouns

Instead of: take into consideration

Write: consider

2. Use strong verbs instead of "to be"

Instead of: The enzyme was found to be the active agent in catalyzing...

Write: The enzyme catalyzed...

3. Use short words.

"I would never use a long word where a short one would answer the purpose. I know there are professors in this country who 'ligate' arteries. Other surgeons tie them, and it stops the bleeding just as well."

Oliver Wendell Holmes, Sr.

Instead of: Write:

possess	have
sufficient	enough
utilize	use
demonstrate	show
assistance	help
terminate	end

4. Use concise terms.

Instead of:	Write:
prior to	before
due to the fact that	because
in a considerable number of cases	often
the vast majority of	most
during the time that	when
in close proximity to	near
it has long been known that	I'm too lazy to look up the reference

5. Use short sentences. A sentence made of more than 40 words should probably be rewritten as two sentences.

"The conjunction 'and' commonly serves to indicate that the writer's mind still functions even when no signs of the phenomenon are noticeable." Rudolf Virchow, 192